The consequences of self-reported vision change in later-life: Evidence from the English Longitudinal Study of Ageing

Abstract

Objectives: Using longitudinal data we investigate whether deterioration and improvement in self-reported vision among people aged 50 and over in England experience subsequent changes in various aspects of economic, psychological and social wellbeing.

Study design: Longitudinal random effects modelling.

Methods: We used six waves of the biennial English Longitudinal Study of Ageing spanning 2002-2012. Self-reported vision change was classed as an increase or decrease in self-reported level of vision between each wave and effects on depression, satisfaction with life, quality of life, social engagement and equivalised income were examined. Models were adjusted for health, employment and wealth.

Results: All wellbeing outcomes worsened among respondents experiencing deterioration in self-reported vision, and declined most among individuals with the poorest self-reported vision at baseline and follow-up. Results were significant in fully adjusted models for those deteriorating from optimal to suboptimal vision levels. Improvement in self-reported vision was associated with significantly better satisfaction with life, quality of life and social engagement when the improvement was from suboptimal to optimal vision levels.

Conclusions: Preventing deterioration in vision is the best means of ensuring wellbeing is not negatively affected by changes to sight. In addition, ensuring vision problems are corrected where possible may lead to improvements in wellbeing.

Key words: Visual impairment, health inequalities, longitudinal study, ageing, mental wellbeing, social engagement

Introduction

Visual decline is a common phenomenon among older people[1,2], and rates of poorer vision increases with age[3,4] as does the prevalence of eye conditions such as glaucoma, cataracts and diabetic retinopathy[2]. Studies have also shown poorer vision to be associated with lower levels of various types of wellbeing, including physical functioning[5-8], self-reported health[5,9], mental health[5,10,11,] an increased risk of mortality[12] and reduced social engagement[5,6,13]. While medical intervention, such as cataract surgery, can significantly improve or restore impaired vision[14], a large number of older individuals with deterioration in vision remain untreatable[15].

Previous research has highlighted socio-economic factors are likely to influence both deterioration in vision as well as uptake of measures to improve impaired vision or prevent sight loss. Both onset of vision impairment and deterioration in vision occur at greater magnitudes among older people in poorer social circumstances[16,17]. This group are more likely to be deterred from using eye health services due to potential treatment costs, such as the need to purchase glasses [18].

Understanding the associations between changes in vision and wellbeing outcomes in relation to social circumstances offers important policy implications. Current evidence focuses mainly on cross-sectional associations between vision impairment and socioeconomic circumstances, without addressing either the impacts of changes in vision over time or potential effects on other areas of wellbeing[5,6]. With an increasing proportion of the older population in the population, the economic and social costs of vision deterioration among older people is an important issue to address. This study uses longitudinal data to examine the impact on wellbeing of changes in the vision of people aged 50 and over in England.

Methods

Sample

The study uses waves 1 to 6 of the English Longitudinal Study of Ageing (ELSA). ELSA is a nationally representative panel study of individuals aged 50 and over living in households that had participated in the Health Survey for England in 1998, 1999 or 2001. Data are collected from participants every two years, with six waves currently available for analysis, spanning a ten year period from 2002-2003 to 2012-2013. This study uses core members from wave 1 aged 50 and over who respond to at least two consecutive waves of ELSA, so that a change in self-reported vision over a two-wave period can be measured. Where respondents have participated in all waves of the survey, five changes in self-reported vision are recorded (waves 1-2, 2-3, 3-4, 4-5 and 5-6). Respondents are included in the data at any point at which they have provided sufficient information. For example, a respondent with missing data at waves 3 and 4 will still have their two measured changes in self-reported vision recorded in the analysis (so in this instance those from waves 1-2 and 5-6). The final sample consists of 28,086 observations (from a potential maximum of 68,964 observations) of vision change from a sample of 8,581 individuals (from a potential maximum of 11,391 individuals).

Measures

Outcome variables

The study examines the impact of self-reported vision change on five outcome measures: depression, satisfaction with life, quality of life, social engagement and equivalised income. Outcomes are measured at the wave at which a change in self-reported vision has been recorded. For example, the impact of a change in vision between waves 1 and 2 is measured by wellbeing at wave 2. Depressive symptoms are measured using an eight-point version of the CES-D score[19]. The score identifies potential indicators of depression (yes/no) in the week prior to interview, such as feeling depressed, lonely or sad, feeling that everything was an effort and restless sleep. The scale ranges from 8 (highest number of depressive symptoms) to 0 (no depressive symptoms).

Satisfaction with life is measured using the Satisfaction With Life Scale[20] and asks the respondent to rate aspects of life satisfaction, such as having achieved important goals and excellence of life conditions, from the response options ranging from 'strongly agree' to 'strongly disagree' on a seven point Likert scale. The scale ranges from 5 (poorest life satisfaction) to 35 (highest life satisfaction).

Quality of life is measured using the CASP scale[21]. A psychometrically validated 15 factor scale is included, rather than the original 19 factor scale[22], and covers aspects such as feelings of control, pleasure, enjoyment, meaning, sociability, happiness, opportunity and satisfaction. When asked how often certain feelings or thoughts are experienced (e.g. 'I look back on my life with a sense of happiness'), the respondent is asked to rate their response to each question as either 'often', 'sometimes', 'not often' and 'never'. The scale ranges from 0 (poorest quality of life) to 45 (highest quality of life).

Social engagement is measured using a binary variable describing whether or not the respondent belongs to any organisations, clubs or societies, including political parties, environmental groups, neighbourhood watch groups, religious groups, charitable associations, educational groups or classes, social clubs and exercise classes or gyms.

Finally, equivalised weekly income is treated as a continuous variable and is comprised of an individual's total income from employment, pensions, benefits, assets and other sources, adjusted to account for household size. The mean equivalised weekly income pooled across waves 1 to 6 is £445.47.

Changes in self-reported vision

ELSA asks respondents to rate their eyesight, using glasses or corrective lenses as usual, within one of the following categories: *excellent*, *very good*, *good*, *fair*, or *poor*. A sixth category of *registered blind* was added where participants spontaneously provided this answer. The analysis here uses the original five-state variable. Those stating they were registered blind were combined with those

stating poor self-reported vision due to low numbers (between 22 and 56 respondents over waves 1 to 6).

Change in self-reported vision here corresponds to an individual moving between two of the ordinal categories between consecutive waves. We reduce the range of potential changes to three conceptual changes in self-reported vision: changes within optimal vision (a two-category change from excellent to good and vice versa), changes within suboptimal vision (a one-category change from fair to poor and vice versa) and changes between optimal and suboptimal vision (a two-category change from very good to fair or from good to poor, and vice versa). It should be noted that the term 'optimal vision' refers only to the fact that the respondent self-reports their vision to be in the highest two response categories of the total five response categories. Accordingly, suboptimal vision refers to the fact that the respondent self-reports their vision to be somewhere in the lower three possible response categories of the total five. The reference category comprises those who see no change in self-reported vision over the two-wave measurement period, or who see change of just one ordinal category outside of suboptimal vision (for example, those moving between excellent and very good). Respondents with a one-step category change are grouped together with those with stable vision because observation of self-reported vision over time shows greater fluctuation when change occurs between close categories (for example, very good and good) and more permanent change when the categories are further apart.

Covariates

The analyses control for a set of covariates which relate to both the risk of vision change and to the various wellbeing outcomes of interest. Covariates are included in the models if they have been shown to demonstrate significant associations with vision in later-life, or if our hypotheses suggest they may confound findings. Gender is a binary variable and results show effects for females. Age is included and divided into five-year age groups in order to account for potential non-linear associations with vision changes. Baseline outcome variables are included in each of the analyses, as

are baseline levels of self-reported vision. Ethnicity is included as a binary variable with categories 'white' and 'non-white'. Social position is measured using both an objective measure of wealth quintiles and a subjective measure of perceived social status. Wealth is measured using quintiles of net total non-pension wealth at the household level, and includes the value of the respondent's home minus outstanding mortgage payments and savings minus debts and loans. Subjective social status (SSS) is measured using a scale of one (lowest social status) to ten (highest social status), where respondents are asked to rate their own perceived social standing as compared to those around them. Education is not included in the models as it does not accurately reflect the cumulative social status of people in later-life and previous work has shown such concepts to be better represented by wealth (de Oliveira et al. 2010). Similarly, SSS has been shown to successfully mediate associations between education, occupational class and wealth in relation to self-reported measures of health (Demakakos et al. 2008).

As changes to self-reported vision might affect working individuals differently than the non-employed, employment status is accounted for with a binary variable depicting those in work and those not. Finally, self-reported health is included in the models, for which respondents could rate their general health as *excellent*, *very good*, *good*, *fair* or *poor*.

Analysis

The final analyses are comprised of models run separately for each of the outcomes of interest. Change in self-reported vision is included as a categorical variable as outlined above. Random effects two-level hierarchical models were used to adjust for clustering in the data (repeat observations within individuals) and obtain parameter estimates alongside their standard errors. The first set of models in the final analyses adjust for gender, age and baseline outcome variables, and the second set of models adjust for gender, age, baseline outcomes, baseline self-reported vision, ethnicity, wealth, SSS and self-rated health. The models are run to show the effect of change in self-reported vision between two consecutive waves of data on outcome scores at the end of the two year change

period. All analyses are weighted using a wave 1 cross-sectional weight and were carried out in Stata 12.

Results

Table 1 shows the rates of self-reported vision change for all observations in the data by gender. A t-test of significant differences in vision changes on the basis of gender was significant with p=0.003. Around 90% of both men and women show stable self-reported vision over each two-wave observation period, or vision which fluctuates only within a one category space. Around 5% of men see some deterioration in vision of any kind over the two-wave measurement period, compared to around 5.5% of women. Around 4% of men and women see an improvement of any kind over the two-wave periods. Men appear to be slightly more likely than women to belong to the group of people seeing either deterioration or improvement within the optimal self-reported vision categories, while a slightly higher percentage of women than men see changes within optimal and suboptimal vision as well as within the consistently suboptimal vision categories.

Table 2 shows characteristics of the sample overall and in relation to self-reported vision changes at baseline (the wave prior to change in vision occurring). Within each change group (within optimal, optimal and suboptimal and within suboptimal), mean age is higher among respondents who go on to experience deterioration rather than improvement. In terms of socio-demographic factors, those with poorer wealth are more likely to see change around the suboptimal categories, in terms of deterioration from optimal to suboptimal vision or within suboptimal vision, as well as in improvement from suboptimal to optimal vision and improvement within suboptimal vision. The richest wealth category are the most likely to see both deterioration and improvement among the optimal categories, rather than experiencing suboptimal vision either at baseline or at follow-up. Higher levels of self-reported health are also associated with changes in self-reported vision within

optimal categories, and poorer levels with change within suboptimal, as well as between optimal and suboptimal.

Table 3 shows the results of the multilevel regression analysis of the effects of changes in self-reported vision on the wellbeing outcomes of interest. Stronger associations appear to exist between deteriorations in self-reported vision and wellbeing outcomes compared with improvements in self-reported vision. The first set of models control for just gender, age, baseline outcome (so the coefficient indicates change in the outcome since baseline) and baseline vision. Deteriorations of any kind of self-reported vision are consistently significantly associated with negative changes in wellbeing. In all instances excepting organisational attainment, the largest coefficients are observed among those experiencing a change from optimal to suboptimal vision. These differences are especially profound for depression and quality of life. For depression, the increase in score for deteriorating from optimal to suboptimal vision (beta 9.91) is around a third larger than deterioration among people who already had suboptimal vision (3.42) and over twice as large as those experiencing deterioration but remaining within the optimal vision categories (beta 5.49). Similarly, deteriorating from optimal to suboptimal vision is associated with a reduction in quality of life around twice as large as deteriorating within suboptimal and within optimal categories (beta coefficients -8.58, -3.67 and -4.42, respectively). The only non-significant association is between deterioration in self-reported vision and income (measured in pounds) among those whose self-reported vision is suboptimal to begin with and, subsequently, on average have low initial incomes.

The second set of models control for ethnicity, wealth, subjective social status, employment status and self-rated health as well as the factors adjusted for in the first set of models. As we would expect, controlling for socio-economic factors and health lead to a reduction in the size of the coefficients for change in self-reported vision and wellbeing outcomes, yet many results remain significant. Again, this is particularly noticeable among those individuals who experience deterioration from optimal to

suboptimal vision. The largest effect appears to be in relation to quality of life, where individuals experiencing a deterioration from optimal to suboptimal vision see a reduction in CASP score of over a whole point (-1.04, beta coefficient -4.78), an impact that is around twice as great as the impact of seeing a deterioration in self-reported vision within optimal categories (-0.59, beta coefficient -2.59) and within suboptimal categories (-0.49, beta coefficient -1.15). CES-D scores are significantly higher, and low organisational engagement is significantly less reported (beta coefficients 4.23 and 1.57, respectively). Deterioration within suboptimal vision is also significantly associated with a worsening of each of these outcomes, although coefficients are smaller. The smaller effects among those experiencing deterioration within suboptimal categories are likely to reflect poorer wellbeing to begin with.

In Model 1, improvement in self-reported vision is associated with better wellbeing in terms of depression, satisfaction with life, quality of life and social engagement when the improvement occurs within the optimal categories of self-reported vision (beta coefficients -3.00, 3.84, 4.88 and -3.65, respectively). Results for the latter three of these outcomes remain significant after adjusting for all covariates (beta coefficients 2.47, 2.73 and -2.36, respectively). Improvement from suboptimal vision categories to optimal categories is only associated with a significant improvement in wellbeing in the case of quality of life, where it is sees an increase of just over half a score (0.57, beta 2.42). However, this result is no longer significant in the fully adjusted model (Model 2).

Table 3 also shows significant associations between the majority of covariates controlled for and the wellbeing outcomes of interest. Where the largest coefficients are observed, among those experiencing a deterioration from optimal to suboptimal levels of self-reported vision, inclusion of the additional socio-economic and health variables reduces the size of the effect of vision on wellbeing by around a half, and the significant association between income and self-reported vision in Model 1 becomes non-significant. A gradient relationship is consistently observed between worsening levels of baseline self-reported vision and worsening wellbeing scores and between self-

rated health and wellbeing scores. Higher wealth and SSS are associated with better wellbeing, and being non-white is consistently associated with poorer outcomes. Being employed is significantly associated with lower depression scores and higher income, but shows no significant relationship with other outcomes.

Discussion

The research presented in this paper demonstrates the importance of understanding the impact of changes in self-reported vision on the psychological, social and financial wellbeing of older people. Changes in all aspects of wellbeing are affected to a greater magnitude by deterioration in self-reported vision, and comparison of standardised results suggests depression and quality of life are most affected. After controlling for demographic and socio-economic factors, the largest effect on wellbeing is that between a decline from optimal to suboptimal levels of self-reported vision and quality of life. Improvement in self-reported vision is also associated with improvement in some areas of wellbeing, including satisfaction with life, quality of life and social engagement. Where wellbeing is adversely impacted by deterioration in self-reported vision, the largest changes are observed among individuals who report a shift from optimal to suboptimal vision. For these people detrimental effects on depression, satisfaction with life, quality of life and organisational engagement remain significant after controlling for a comprehensive range of socio-economic and health factors. The findings suggest that, although improving vision might lead to slightly better wellbeing, preventing vision deterioration in the first place will prevent a greater degree of decline in all areas of wellbeing.

The study presented herein ties in with previous research which has found associations in later-life between poorer levels of vision and wellbeing, including depression[23], satisfaction with life[24] , quality of life[25] and functional ability which may impact an individual's ability to be socially engaged in later life[26]. Furthermore, previous studies have also demonstrated a worsening of wellbeing with deterioration in vision[27] and an improvement after treatment of poor vision[27,28]. However, the

majority of previous work on changes in vision and subsequent effects on wellbeing focus on samples taken from patient and clinic settings, all of whom already have poor vision. Conversely, this study uses a nationally representative population, where deterioration in vision encompasses even a decline within higher levels of vision, rather than only within or into the poorest levels. This is likely to explain the smaller effects produced by this study of improvements in vision, as improvements are measured from all baseline levels of vision, rather than just those which are very poor. This study is also the first large scale longitudinal analysis of changes in self-reported vision which is nationally representative.

There are some limitations to this study. As with all longitudinal data there are potential problems associated with attrition within the ELSA dataset, with individuals who are in poorer health and poorer wealth circumstances increasingly likely to drop out of the study over time[29]. Poorer vision shows associations with both of these factors, and previous research using ELSA and self-reported vision have shown a higher proportion of individuals have better levels of self-reported vision than the actual population of people aged 50 and over in England[16]. As a result, the findings of the current research are likely to be underestimated compared to the potential findings unaffected by this attrition. Although weights are used to address issues of bias arising from non-response, they might not correct for all factors of interest.

Another limitation arises from the fact that there may be discrepancies between an individual's self-reported vision, the variable for which is used in the study, and their objectively measured vision. However, it has been argued that self-reported vision is multidimensional and likely to encompass aspects of vision which directly affect the daily life of older people, such as the ability to carry out tasks in low lighting or in low contrast settings and increased risk of falls[4,30,31,32, 33,34]. As such, a self-reported measure might more accurately reflect vision in relation to everyday functioning. Evidence has even suggested the wider aspects of vision encompassed by a self-assessed measure correlates better with sight-related physical functioning than with objective measures of acuity[34]. Additionally,

the self-reported measure of vision used in ELSA has been shown to correlate well with visual acuity[35]. Finally, research has suggested that because self-reported measures of vision may encompass a greater number of factors relating to everyday living than objective measures of vision, self-reported vision shows greater associations with mental wellbeing than objective measures[10].

Finally, it should be noted that the analyses presented here are only able to account for changes in wellbeing over a two year period, and that the long-term effects of changes in self-reported vision are likely to be larger than the short-term effects discussed herein. A related limitation to this is that, due to the biennial nature of ELSA, it is impossible to distinguish the precise timeframe between exposure and outcome, which may be anything up to two years. Again, short-term differences in length of time between changes in self-reported vision and wellbeing are not well-reported. These points pose interesting questions for potential future research on the topic.

From a policy perspective, the findings of this study highlight the need to ensure that the provision of healthcare services is appropriate for the needs of those older people at risk of vision loss. Given the greater magnitude of effects on wellbeing in relation to deterioration in self-reported vision compared to improvement, the most effective measures might be focused on ensuring that the worsening of vision among older people is prevented. Currently, all people aged 60-69 in the UK are entitled to a free eye test every two years, and from age 70 this changes to yearly. A commonly reported barrier to taking advantage of these free eye tests is physical access to the service[36] and as a result the NHS offers funded eye tests within the home for people aged 60 and over who are unable to leave the house due to disability or illness. However, in 2007 only 47% of people aged 60-69 reported having a biennial eye test, and only 55% of people aged 70 and over had an annual eye test[36].

The potential cost of purchasing glasses or contact lenses following an eye test is another commonly reported barrier to using the free eye test service[18,36,37] although vouchers are available to aid with the cost to people in receipt of certain benefits, as well as those with stronger and more complex

lens prescriptions. Older people on lower incomes, however, are those most likely to be deterred from the uptake of free eye tests due to the subsequent cost of glasses[36,37]. Research has also shown people with the poorest vision are more likely to live in deprived areas[38,39] and that people with eye conditions such as glaucoma are more likely to seek medical help in later stages of the disease if they live in areas marked by higher rates of deprivation[40]. As well as ensuring affordability of eye care and distribution of information on schemes to aid affordability covers groups of people who might need it the most, such as those from poorer areas, policy should also focus on ensuring these people have access to resources on symptoms of eye disease and how early intervention might prevent serious vision loss.

Increasing the uptake of free eye tests among older people potentially provides an effective means of protecting against vision decline[41] and the subsequent decline in mental, social and financial wellbeing associated with worsening sight. Early identification of vision problems would also enable treatment to retain or even improve vision levels. Onset of eye disease is associated with subsequent rapid deterioration in vision[16] and so early detection of problems by regular eye tests might provide a useful means of preventing deteriorations in vision and their consequent implications. Policies to address these issues also need to focus on those most likely to experience a deterioration in vision, those who are poorer, have poorer general health and have medical conditions likely to increase their risk.

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Ethical approval

Ethical approval was not sought for this research. The observational data used are anonymous.

Competing interest

The authors have no competing interests.

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Table 1. Frequency (%) of men and women in each category of vision change.

	Male (N=20,000)	Female (N=23,616)
Stable vision (no change over 2-wave period)	18,198 (90.99)	21,290 (90.15)
Within optimal deterioration (excellent to good)	466 (2.33)	473 (2.00)
Optimal to suboptimal deterioration (very good to fair)	340 (1.70)	453 (1.92)
Within suboptimal deterioration (fair to poor)	190 (0.95)	375 (1.59)
Within optimal improvement (good to excellent)	397 (1.99)	406 (1.72)
Suboptimal to optimal improvement (fair to very good)	256 (1.28)	394 (1.67)
Within suboptimal improvement (poor to fair)	152 (0.76)	225 (0.95)

Table 2. Descriptive statistics for each category of vision change at baseline, before change in vision occurs (weighted using wave 1 cross-sectional weight)

		Deterioration			Improvement				
	Stable vision	Within optimal	Optimal-suboptimal	Within suboptimal	Within optimal	Suboptimal-optimal	Within suboptimal	Total	Overall p values for comparison (ANOVA)
Gender (%)									
Female	53.92	50.35	57.10	66.43	50.55	60.59	59.67	54.15	0.000
Age									
Mean (S.D.)	67.61 (9.79)	67.27 (9.31)	72.84 (10.71)	76.44 (9.73)	66.80 (9.18)	70.75 (10.64)	73.76 (9.95)	66.46 (9.87)	0.000
Ethnicity (%)									
Non-white	2.31	1.89	3.14	3.98	1.86	3.19	6.03	2.37	0.000
Wealth quintile (%)									
Worst off	17.83	16.62	29.11	34.94	15.70	31.08	36.94	18.52	0.000
2nd	19.25	18.06	24.91	25.74	20.45	25.94	24.61	19.56	
Middle	20.62	21.91	18.27	14.37	18.58	16.85	18.95	20.42	

4th	20.95	20.60	16.26	16.26	20.16	15.99	11.47	20.64	
Best off	21.36	22.80	11.44	8.70	25.10	10.14	8.03	20.86	
Subjective social status (%)									
Worst off	2.88	2.72	7.46	4.65	1.97	4.32	7.85	3.00	0.000
2nd	16.46	13.24	22.32	25.83	14.16	24.33	28.08	16.71	
Middle	44.02	45.08	46.62	48.38	41.46	46.67	41.67	44.09	
4th	32.28	34.18	19.97	19.16	37.91	22.42	19.45	31.89	
Best off	4.36	4.78	3.63	1.99	4.49	2.26	2.95	4.30	
Self-rated health (%)									
Excellent	13.90	14.14	6.69	2.48	26.61	7.01	3.47	13.69	0.000
Very good	31.86	32.74	19.46	15.56	28.66	24.99	12.27	31.14	
Good	31.16	32.66	28.70	31.85	26.59	32.55	30.60	31.09	
Fair	17.10	15.32	29.27	31.88	13.48	21.89	34.87	17.60	
Poor	5.98	5.14	15.88	18.23	4.66	13.56	18.79	6.47	
Mean baseline wellbeing scores (S.D.)									
CES-D	1.38	1.34	2.10	2.40	1.21	2.27	2.69	1.44	0.000

	(1.86)	(1.78)	(2.18)	(2.27)	(1.68)	(2.27)	(2.30)	(1.90)	
SWL	25.85	26.44	24.63	23.54	26.30	24.65	22.92	25.77	0.000
	(6.10)	(5.99)	(6.85)	(7.69)	(5.98)	(6.49)	(7.38)	(6.17)	
CASP	34.90	35.48	32.07	30.67	35.40	31.43	29.25	34.69	0.000
	(6.84)	(6.61)	(7.55)	(8.16)	(6.52)	(7.80)	(8.25)	(6.97)	
Social engagement	25.59	24.96	33.19	37.25	24.24	38.20	47.98	26.32	0.000
(% not engaged)									
Equivalised income	431.38	440.12	327.29	295.63	427.98	306.30	281.27	422.34	0.000
	(650.21)	(833.35)	(439.08)	(476.71)	(364.52)	(255.62)	(246.89)	(635.58)	

Table 3. Effect of changes in vision on wellbeing outcomes (regression coefficients and standard errors).

	Model 1 (controls for gender, age group, baseline outcome and baseline vision).					Model 2 (additionally controlling for ethnicity, wealth, perceived social status, employment status and self-reported health).				
	CES-D	SWLS	CASP	Low organisational engagement	Income	CES-D	SWLS	CASP	Low organisational engagement	Income
Change in vision										
Stable vision (reference)										
Deterioration										
Within optimal	0.23***	-0.75**	-1.05***	0.02*	-38.53*	0.07	-0.38*	-0.59**	0.01	-27.86
Optimal to suboptimal	0.58***	-0.87***	-1.83***	0.05***	-47.77*	0.29***	-0.38*	-1.04***	0.03*	-9.27
Within suboptimal	0.36***	-0.78*	-0.80**	0.10***	-30.83	0.27**	-0.39*	-0.49*	0.07**	-1.94
Improvement										
Within optimal	-0.16**	0.76**	0.80***	-0.04**	26.33	-0.04	0.50*	0.43*	-0.04**	12.18
Suboptimal to optimal	-0.13	0.27	0.57*	-0.03	26.04	-0.06	0.18	0.40	-0.01	20.53
Within suboptimal	-0.07	-0.42	-0.02	0.02	85.99**	0.03	-0.26	0.03	0.02	0.41
Gender	0.25***	-0.23**	0.01	0.02*	-33.64***	0.30***	-0.15	0.10	0.01	-10.95

Female(reference: male)										
Age group										
50-54 (reference)										
55-59	-0.02	0.33	-0.14	0.02	49.31*	-0.04	0.39	-0.17	0.02	35.83
60-64	-0.07	0.98*	0.07	0.03*	32.82	-0.18**	1.24**	0.25	0.03*	54.61**
65-69	-0.07	1.12**	0.05	0.03*	-1.52	-0.24***	1.52***	0.35	0.03	52.31**
70-74	-0.04	1.10**	-0.29	0.02*	-48.73*	-0.25***	1.62***	0.19	0.01	21.48
75-79	0.03	1.15**	-0.80***	0.04*	-70.68***	-0.23***	1.76***	-0.27	0.02	10.79
80+	0.20**	0.81*	-1.65***	0.07	-71.72***	-0.08	1.50***	-1.07***	0.03	12.57
Baseline outcome	0.44***	0.57***	0.59***	-0.01***	0.04***	0.33***	0.50***	0.50***	-0.01***	0.11***
Baseline vision										
Excellent (reference)										
Very good	0.08**	-0.45***	-0.67***	0.03***	-16.99	0.00	-0.22*	-0.37***	0.02**	2.68
Good	0.29***	-1.01***	-1.23***	0.05***	-37.16**	0.08*	-0.56***	-0.64***	0.03***	1.56
Fair	0.59***	-1.39***	-2.03***	0.08***	-56.89***	0.20**	-0.69***	-1.03***	0.06***	5.11
Poor/blind	0.83***	-1.93***	-3.23***	0.14***	-11.52***	0.24*	-0.86**	-1.79***	0.09***	0.87
Non-white						0.22**	-0.05	-0.29	0.02	-29.57
Wealth (quintile)						-0.05***	0.06*	0.18***	-0.05***	48.35***
Subjective social status						-0.15***	0.99***	0.96***	-0.02***	44.13***

Employed						-0.10***	0.07	0.15	0.00	106.12***
Self-reported health										
Excellent (reference)										
Very good						0.14***	-0.35**	-0.68***	0.02*	-9.13
Good						0.41***	-0.70***	-1.37***	0.02**	-10.82
Fair						0.88***	-1.40***	-2.59***	0.07***	-6.91
Poor						1.80***	-3.10***	-5.03***	0.08***	44.14**
Constant	0.43***	10.84***	15.08***	0.20***	370.43***	1.10***	9.01***	15.05***	0.39***	57.89***

***p<0.001 **p<0.01 *p<0.05. Coefficients are mutually adjusted.